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GEIGER, R. **The Climate near the Ground.** Havard Trans. Scripta Technica, Inc., Harvard University Press, Revised Edition, 1965, 611 pages Published in Canada by Saunders of Toronto.

Although ostensibly dealing with agriculture, this monograph contains basic surveys of current theory and practice in the study of the climate near the ground, which lends to the work a much wider appeal than the title might at first suggest, and a special attraction for geographers.

The individual papers cover three broad topics : the physical understanding of the energy exchanges between atmosphere, soil and organisms, which result in the observed temperature, wind and moisture distributions of the environment ; the nature of the plant and animal responses to these conditions ; the application of this knowledge in decision making in farming and in the design of short and long range agricultural weather forecasts. For publication, the articles have been grouped under the headings, radiant and sensible heat, transport by the wind, water, and foreseeing the future. A valuable bibliography follows each paper.

The study is opened by D. M. Gates, who gives a lucid account of the spectral distribution of the radiant energy available at the earth's surface, the variations in this energy due to such factors as cloud cover and topography, and the absorption, reflection and transmission of this energy by plants ; the chapter concludes with a useful assessment of the various instruments available for measuring radiation. This discussion is followed by E. K. Webb's paper on aerial microclimate, which deals essentially with turbulence and energy exchange in the first few tens of metres above the ground. Again, the treatment is concise but comprehensive, including current theory, past observations, methods of measurement and estimation, and application with respect to reservoir and crop surfaces, plants and animals. The third chapter by R. W. Van Wijk treats the microclimate of the soil, with emphasis on the heat flow and temperature in different soils in relation to plant growth. These three basic chapters on the heat exchange processes comprise almost one half of the monograph.

Still under the main heading, heat, the next papers are concerned with plant and animal response — survival, growth and yield. Businger, Crawford and Hendershott cover the question of frost action on plants, and protective measures. D. N. Moss, in a paper on the capture of radiant energy by plants, emphasizes the need to study the fundamental processes of photosynthesis and transpiration through instantaneous and continuous measurement ; conclusions drawn from the correlation of seasonal weather and yields, or even from the measurement of weather and growth over periods as short as a week, are based on such a complex of variables that the knowledge is of relatively limited use in application. Here is the perpetual problem of trying to measure process under complex natural conditions as against controlled laboratory experiments. Again, in the next article on the response of animals to heat (H. D. Johnson), emphasis is placed on the understanding of the physiological and biochemical processes involved, and of the processes and time-scales of adaptation.

After a brief survey of wind action in lifting, transporting and depositing soil (or snow) and of the principles of control (W. S. Chepil), and a paper by W. R. Henson and P. E. Waggoner on the role of wind in transporting parasitic insects and pathogenic fungi, the second major element, water, comes under review.

Not only does the life of the plant depend on water, but it has been estimated that nearly three-quarters of the water received by a land such as the United States is lost by evapotranspiration from farm and forest and grassland. The principal questions under discussion are the dynamics of soil moisture (the amount of soil water available), and of the plant system by which water enters the roots and is evaporated at the leaf surface. Papers by W. R. Gardner and B. Slavik deal respectively with these two topics. In the last article in this section C. W. Thornthwaite and F. K. Hare survey the loss of water to the air by evaporation and evapotranspiration, the possibilities of estimating and measuring these quantities, and applications in irrigation.

The final chapter of the monograph is directed towards weather forecasting and farm management. As the significant and critical weather situations become better-defined with

respect to biological response, the weather forecast becomes a more important factor in decision making in farming. Once the cost/loss ratio has been carefully estimated for specific weather-sensitive decisions, alternatives, and sequences of decisions, considerable economic advantage is to be gained by using weather forecasts for short-term planning, and probability forecasts based on climatology for long-term decisions.

The theme underlying this important collection of papers is that, to be most effective, application in agricultural meteorology must be based on adequate understanding of the energy-exchange processes between plants and animals and the atmosphere. There are two major approaches : firstly, the biochemical modification of varieties and breeds to withstand less favourable weather, and secondly, either the subtle modification of the « natural » micro-climates or the creation of « optimum » artificial indoor climates. With the need for more efficient food production in many countries of different climatic regimes, and with the extensive dietary changes that are being introduced in many parts of the world today, this excellent survey of current knowledge in agricultural meteorology deserves a place in any geographical collection.

An English translation has recently been published of the fourth (1961) edition of Rudolf Geiger's * now classic work on microclimatology, the *Climate near the ground.* It is nearly 40 years since Mr. Geiger's book first appeared, in which he gathered together his own and others' experience in trying to apply meteorological and climatological research to the layer of air near the ground. In the 16 years between the third and fourth editions, new developments have permitted not only a clearer definition of the field, but an important extension in the applications, and the book has now been partly reorganized and largely rewritten.

Most meteorological stations are set up to take measurements that can be considered representative of a wider area. Those differences between stations which are due to local surface conditions are reduced or eliminated by housing the temperature and humidity instruments in ventilated shelters, about 2 metres above the ground, placing anemometers at roof level, and suitably exposing precipitation gauges. The synthesis of these standardized measurements provides a picture of the macro-climate. In micro-climatology it is precisely the variations in the layer near the ground, below the 2-metre shelter level, that are being investigated. Here is the actual zone of contact between the earth's surface and the air, in which radiant and sensible heat are exchanged according to the powers of absorption and reflectivity of the surface, where water vapour, other gases and particles enter the atmosphere, and where the roughness of the surface reduces the horizontal windspeed and influences the turbulence of the flow. Above all, this is where we live and work and have our being.

After defining the subject in a brief introduction, Geiger devotes the first chapter to the basic study of the heat balance at the earth's surface, in which he describes the laws that govern the processes in the air close to the ground. In chapter 2, the author deals with the processes themselves. Assuming, for the sake of simplicity a « normal » surface of level ground, without vegetation, he describes what is known from observation of the development of the vertical structure in the air layer above the ground ; this is followed by a detailed discussion of the influence, on this layer of air, of the underlying surface itself (soils, water, snow and ice). In chapter 4, all these ideas are synthesized in considering the quantitative determination of the heat balance factors. The next steps are to introduce the complexities that arise from the presence of a vegetation cover (and the particular case of the forest), and to discuss the influence of topography. Finally, Geiger is concerned with the relations of man and animals to microclimate and his last chapter includes such topics as the climate of enclosed spaces (crypto-climate), city climate and pollution, and artificial protection from wind and from frost. This fourth edition also contains a new and valuable section on measurement techniques in micro-climatological and micrometeorological investigations by Gustav Hofmann. The selected bibliography lists 1,218 items, covering the period up to 1959.

The English translation provides a clear and readable text, and it is not often that one is reminded of the fact that the original text is in German. However, the retaining of « z » (*zeite*) for time, and the use of « x » for height is at first confusing to an english-speaking reader.

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The author mentions in his preface, that as well as providing a reference book for those familiar with the subject, he had in mind to produce a clear and vivid textbook for those coming new to it, whether in the field of climate or in related sciences. « I was thinking of all who work on the land, in forests and gardens, the architects, geographers, country planners, entomologists, doctors, transportation engineers and others who — without having studied much physics — were anxious to acquire a knowledge of the rational, physical principles governing the meteorologic laws that they have to put into practice. » Today, one truly appreciates more than ever before, a lucid evaluation and synthesis of work done in a particular field. To quote Geiger again, « ... without useful signposts no one can find his way any more in the labyrinth of science. » For this most useful signpost let us give thanks.

Cynthia WILSON

GÉOMORPHOLOGIE

SAINT-ONGE, Denis. **La géomorphologie de l'île Ellef Ringnes,** Territoires du Nord-Ouest, Canada. Ministère des mines et des relevés techniques, Direction de la géographie, Ottawa, 1965, 58 pages ; étude géographique n° 38.

The island of Ellef Ringnes in the Canadian Arctic, contains many features of geomorphological interest. This report describes these features verbally and indicates their distribution on geomorphological maps covering a small area in detail as well as the whole island on a smaller scale. The arrangement of the report is on a systematic basis, the first main chapter being devoted to the physical environment including geology and climate. The next two chapters are concerned respectively with forms associated with permafrost and nivation. The fifth chapter describes slope development and in the sixth hydrological processes are discussed. A short chapter on glaciation demonstrates that the effect of this process is minimal in accounting for the existing landforms. The interesting superficial deposits dating from late Tertiary or early Quaternary are considered next, and the final chapter points out the value of geomorphological mapping in introducing the maps included at the end of the report. A valuable conclusion summarises the report and draws attention to the salient processes that have produced the landforms of this arctic island. It is pointed out that raised shorelines do not extend far vertically and that, in the absence of strong glacial effects, fluvial action has been and is the dominant process operating in this area. However, it is pointed out that fluvial processes in this periglacial climate, bear some resemblance to those in semi-arid areas in the very short period of rapid run-off during which the flow is very effective. Isostatic uplift, although much less than in other parts of the Canadian Arctic, is partly responsible for the effectiveness of fluvial action, allowing incision of the streams.

The report has a useful bibliography. Twenty-six photographs both from ground and air viewpoints clarify and illustrate the text very effectively. The figures include details of sediment size and shape analysis, surveyed slope profiles and climatic data. The latter illustrate clearly the much greater range of temperature recorded on the ground than in the screen. Smaller scale maps show where the photographs were taken and illustrate the drainage pattern. There are two maps of the whole island on a scale of 1:50,000. One shows the lithology and the minor periglacial forms so that the relationship between these two factors can be appreciated. The other shows the morphological features by using coloured symbols. Structural features are shown in grey, and these bring out the structural grain of the country well where this is obvious on aerial photographs, from which part of the map was compiled. Deposits of fluvial and raised marine origin are differentiated by colour, but the difference is subtle and the distinction cannot be appreciated readily. It would have been useful to indicate the position and height of the marine limit on the map. All the remaining symbols are linear and relate to small and large water courses. They indicate the type of channel and valley. The use of linear symbols to denote slope characteristics is more questionable as there is little indication of the extent of the slope. Some attempt has been made to differentiate slope height, by use of different types of line, but the result is not altogether satisfactory and is not very easy to appreciate. Nevertheless